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SYSTEMATIC MINERALOGY

Text-Book of Systematic Mineralogy. By Hilary Bauerman, F.G.S., Associate of the Royal School of Mines. (London: Longmans, Green, and Co., 1881.)

THE text-books of Mineralogy written for English readers are so extremely small in number that the publication of a new one may be almost looked upon as an epoch in the history of the science. The text-books already in existence are in many respects very unsatisfactory, and in general character fall far below the standard of those of France and Germany. The symbols adopted in them for the faces of crystals are generally those of Naumann, whilst the simple and elegant symbols of Miller, if mentioned at all, seem to be regarded as intended for ornament rather than for use. As for the advances made by theoretic crystallography during the last quarter of a century, no account, save that to be found in the excellent little work of Mr. Gurney, has yet been offered to the English student.

Mr. Bauerman had thus a clear field and a splendid opportunity. It will be interesting to consider how far the result of his labour is worthy of the occasion.

We find, on opening the book, that the Descriptive Mineralogy, which the author's wide experience and extensive travel should render highly instructive, has been assigned through force of circumstances to a supplementary volume: of the 367 pages of the present one, 200 are given up to the geometrical, 100 to the physical, chiefly optical, and the remainder to the chemical and other properties of minerals. One immediately remarks with pleasure the numerous figures of crystals distributed throughout the work, all well drawn and clearly printed, and what is almost as important to the student, having wherever practicable the Millerian indices affixed to the faces.

On coming to the letterpress, however, one soon finds that there is something wrong; in fact, from the first page almost to the last there seems an evident disposition to perplex the reader. The style is very confusing throughout. On p. 5, for instance, we are informed that "quartzite and statuary marbles are aggregates of particles of quartz and calcite into masses of a slaty or granular texture." On p. 7 we find the following:—

"The leading property of crystals, as distinguished from mere geometrical solids, is the invariability of the angles between corresponding faces in different individuals of the same substance. There is usually a very marked *symmetry* to be noticed in the arrangement of their plane faces and edges, and occasionally of their points also, although the latter symmetry is not essential, crystallographic symmetry being one of direction and not of position, so that two parallel planes or two parallel lines are not distinguished from one another, and on that account the invariability of the angles is a paramount consideration."

Leaving out of sight the fact that the accuracy of the above distinction may be very reasonably contested, we much doubt the ability of the ordinary mineralogical student to master the compound nature of the latter sentence. On p. 10 we are puzzled on being told that "a poly-

hedron may be turned through an aliquot part of a whole revolution without its position in space as a whole being changed"; on p. 12 we find that the tetragonal system is characterised by the existence of *two* axes of binary symmetry, while on p. 112 *four* are mentioned; on p. 15 we are informed that if α , β , γ are all different, the molecular net-work has no symmetry, while on the following page it is said that, granted certain relations between these different quantities, there will be symmetry; on p. 19 we are told that the values of h , k , l are in no wise altered by multiplying them by any numerical co-efficient; and from p. 24 it will be concluded that a crystal with a "concave" angle is necessarily a twin.

On p. 36 it is stated that "the test of whether we have really four faces of *one* crystal is the rationality of this anharmonic sine-ratio when reduced to numbers." It is a well-known fact that in every zone of the cubic system, and in particular zones of the tetragonal and rhombohedral systems, the anharmonic ratio of any four planes belonging to *two* twinned crystals will be rational.

The account of the inter relations of the various holohedral forms of each crystallographic system is not such as will relieve this branch of the subject from being still looked upon by the English student as somewhat dry and wearisome, while the attempt to evolve the hemihedral forms must cause the learner to despair. Thus the chapter on the Tetragonal System begins as follows:—

"The complete symmetry of this system is contained in an upright prism upon a square base, which has quaternary symmetry about a principal axis parallel to the vertical edges, and binary about four lateral axes."

Instead of an explanation there is then a statement of the fact that only certain permutations of the indices are possible: next follows a calculation, one of the principal features of which is the use of some spherical triangle characterised only by the fact that it is described *about* the pole of the principal axis and has a side represented by π , which symbol has been unfortunately selected to represent an *arbitrary* arc. The hemihedral forms are then arrived at by arranging the symbols of the faces of a complete form in a particular order, and then halving the faces, or the symbols, or the table, it is not clear which, in some symmetrical way not easy to discover (see pp. 89 and 120).

On p. 152 we find that, in the case of oblique crystals the axis of symmetry is a direction of "physical equivalence," while from p. 156 we should conclude that a face is "crystallographically possible" when it has a similar face parallel to itself.

In the discussion of twin crystals the relation in which the twin axis and the twin plane stand to the lines and planes of the crystalloid system is not clearly expressed. It may be worth while to point out that on p. 170 the somewhat common error is made of considering a face of the cube as the twin plane of the two interpenetrant tetrahedra, whereas a little reflection will make it clear that the twin plane is really a dodecahedral face. On p. 352 the striations on the cube faces of iron pyrites are, strange to say, referred to as *twin striations*. In describing a goniometer, of which the picture on p. 192 is no doubt very ideal, it is remarked that "the angle through which the circle is rotated will be the supplement of the dihedral angle required, *if it was originally set to zero.*"

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On the same page a probable injustice is done to the instrument, for we find that "in all cases the observation must be often repeated to obtain results of any value." What can be meant by the statement on p. 198, that the octahedron, or unit pyramid, is always the largest, and the cube rectangular prism, or pinakoid the smallest, of the constituent forms of any combination? On p. 205 we learn that density and hardness are common to all solids alike, and are therefore *independent of structure*. A definition (p. 212) informs us that a substance is *ductile* when it can be cut with a knife, but crushes to powder under a hammer, copper pyrites being cited as an example; and on the same page we find as an illustration of toughness of a mineral that "Malleable native Copper, especially when intimately mixed with siliceous vein-stuff and some varieties of Hematite and Iron Pyrites, has the property of toughness in a high degree."

The discussion of the optical properties is more unsatisfactory still. On p. 225 is to be found the following remarkable statement:—

"The movements in such a medium can only be reduced to order by supposing them to be made up of portions of homogeneous substances of different properties, and treating each one separately."

The proof of the existence of a minimum angle of deviation as submitted on p. 233 can scarcely be meant as serious; but to this curious proof should not have been appended an erroneous translation of the formula into words. On p. 235 the azimuths of vibration of an ordinary ray of light are said to change *continuously*, but so very rapidly that the changes are not perceptible to the eye; on the following page we read of "impulses having different velocities." Perhaps matters reach a climax about p. 245, where the intelligibility of the book for a brief period suffers total eclipse, as perhaps may be imagined when we read that "these orthogonal *forces* are called the *axes* of optical elasticity." On p. 263 one of the rays produced by double refraction is said to be "an extraordinary ray in all directions but those of the optic axes." Phosphorescence is, according to p. 290, "the power of emitting light in a dark place." On p. 293 we find a serious misapprehension as to the precise nature of the method employed by Fizeau for the determination of the expansion of crystals. One infers from the explanation here given that the interference rings, produced by help of a plane crystal surface and a lens, are *distorted* on change of temperature, and that the measurement of this distortion serves for the determination of the coefficient of dilatation for different directions in the plane surface; as a matter of fact Fizeau by his method determined with each crystal section the dilatation in only *one* direction, namely, that normal to the plane surface.

It is difficult to understand how Mr. Bauerman has contrived to allow so many loose statements to creep into his book; and we can only surmise that he has himself not had the time or the opportunity for a careful revision of the proofs. At any rate it will be evident from the above that a careful revision is absolutely required before the book can take its proper place in mineralogical literature. We trust that the present edition may be speedily disposed of, and that Mr. Bauerman will thus be enabled to offer to the English student a second and revised edition of a work, the want of which is urgently felt by every teacher of the subject.

L. FLETCHER

A TREATISE ON CHEMISTRY

A Treatise on Chemistry. By H. E. Roscoe, F.R.S., and C. Schorlemmer, F.R.S., Professors of Chemistry in the Victoria University, Owens College, Manchester. Vol. III. The Chemistry of the Hydrocarbons and their Derivatives, or Organic Chemistry. Part I. 8vo. (London: Macmillan and Co., 1881.)

THE term "Organic Chemistry" was originally used to denote the chemistry of compounds produced in the living vegetable or animal organism, all of which contain the element CARBON. For a long time indeed it was supposed that these compounds were peculiarly the products of living organisms, being formed under the influence of a so-called *vital force*, and that they could not be produced, like those of the mineral world, by artificial means. But the course of research has shown that this idea was erroneous, and that a large number of the more important organic bodies—hydrocarbons, alcohols, acids, &c., originally known only as products of the living organism—can be formed synthetically from their ultimate elements. The name "Organic Chemistry" has thus acquired a new signification, and in its widest sense is now used to denote the chemistry of carbon-compounds. As however some of these compounds, viz. the oxides and sulphide of carbon, have long been known to be producible by direct combination of their elements, and have accordingly been described in Manuals of Chemistry amongst inorganic compounds, the authors of the present treatise have thought it desirable to use the term "Organic Chemistry" in a somewhat narrower sense, viz. as signifying the CHEMISTRY OF THE HYDROCARBONS AND THEIR DERIVATIVES.

The volume commences with a historical sketch of the development of this department of the science, tracing it from the few facts respecting organic bodies known to the ancients, to the discoveries of Scheele, Lavoisier, Berzelius, Liebig, and numerous other workers, down to the present time—dwelling especially on the idea of Compound Radicals introduced by Lavoisier, and further developed by Berzelius, and by Liebig and Wöhler in their classical research on Bitter Almond Oil and its Derivatives, published in 1837—thence to the theories of Substitution and Types, founded chiefly on the researches of Dumas, and of Laurent and Gerhardt, and to the subsequent fusion of the Radical and Type theories brought about by the experiments of Williamson on Etherification, and those of Wurtz and Hofmann on the Compound Ammonias.

The next division of the work treats of the methods of ORGANIC ANALYSIS, which are explained in considerable detail, and illustrated by admirable diagrams; also of the determination of Vapour-density, in which the latest methods introduced by Victor Meyer are fully described, after which we come to the Determination of Molecular Formulæ, the explanations of which are characterised by singular clearness.

Next follows the CLASSIFICATION OF CARBON-COMPOUNDS, which are divided into groups according to the mode of linking of the carbon-atoms, the principal divisions being the Fatty or Paraffin group, in which the carbon-atoms are joined together in a single open chain, and of the Aromatic or Benzene group, in which the